Christian de Duve, in the quotation above, refers to the "no-man's-land" in which these mechanisms resided.[1] To discover them, researchers needed new instruments and strategies of investigation. Those will be the focus of the next chapter. Nonetheless, cell biologists utilized knowledge obtained in both cytology and biochemistry in their investigations. Thus, before turning to cell biology proper, I need to consider both what cytology and biochemistry could provide as well as their limitations when it came to the activities of cell life. I will pursue this project historically, examining, albeit in abbreviated fashion, how both cytology and biochemistry reached the state they had by 1940.

The differences between cytology and biochemistry involved not just the size of the objects of their study. Both fields were engaged in decomposing living systems, but cytology emphasized the structural decomposition of tissues, first into cells and then into organelles, while biochemistry emphasized functional decomposition of metabolic activities down to individual biochemical reactions.

1. CYTOLOGICAL CONTRIBUTIONS TO DISCOVERING CELL MECHANISMS UP TO 1940

Because cells are generally too small to be seen by the naked eye, their discovery depended on the development of what was in the seventeenth century a new tool – the microscope. The origins of the microscope are obscure but likely involved someone inserting a lens into a viewing tube, which would provide an approximately tenfold increase in magnification. Anton van Leeuwenhoek became familiar with the use of lenses to magnify cloth to count its threads when he was an apprentice in a dry goods store in Holland. He established new methods for grinding and polishing lenses and made a single-lens microscope that magnified objects up to 270 times. Using this instrument, van Leeuwenhoek identified what he termed *animalcules* in blood, sperm, and water from marshes and ponds. In the same period Robert Hooke[2] developed a compound

[1] de Duve (1984, p. 11) again used the metaphor of a no-man's-land and referred to the region as *terra incognita* in characterizing knowledge of cells at the beginning of the 1940s: "there remained between the smallest entity discernible in the light microscope and the largest molecular size accessible to chemistry, an unexplored no-man's-land extending over two orders of magnitude, a vast region that had to be labeled terra incognita on the map of the living cell."

[2] Other investigators of the period who reported looking at plant and, sometimes, animal tissue with microscopes, included Nehemiah Grew, Marcello Malpighi, and Jan Swammerdam. See Hughes (1959) for a more detailed account of this early history. Gall (1996) presented pictures of several early microscopes as well as investigators' drawings of what they saw.